An update on the Saginaw Bay multiple stressors project

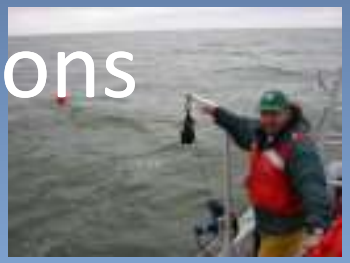
5 year grant
NOAA Center for Sponsored Coastal Ocean Research

NOAA Great Lakes Environmental Research Laboratory
Michigan State University
University of Michigan
University of Akron
Limno-Tech, Inc.
Western Michigan University
Michigan Department of Natural Resources
Michigan Department of Environmental Quality

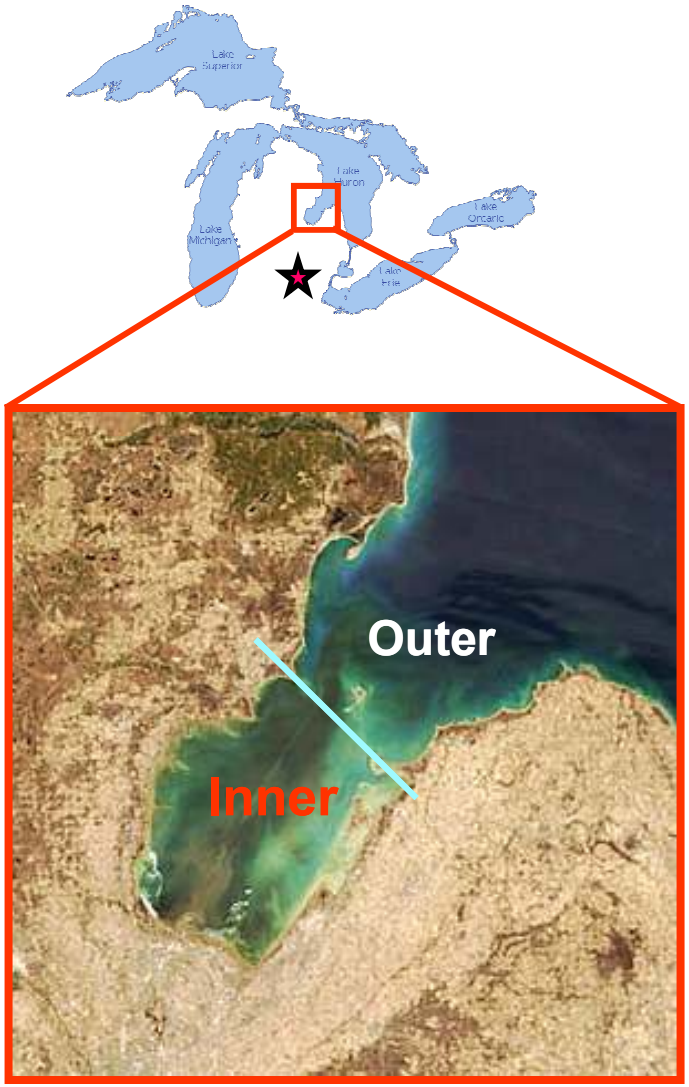
Also featuring
Wayne State
Purdue
Case Western
Duke
Eastern MI

Project has several components

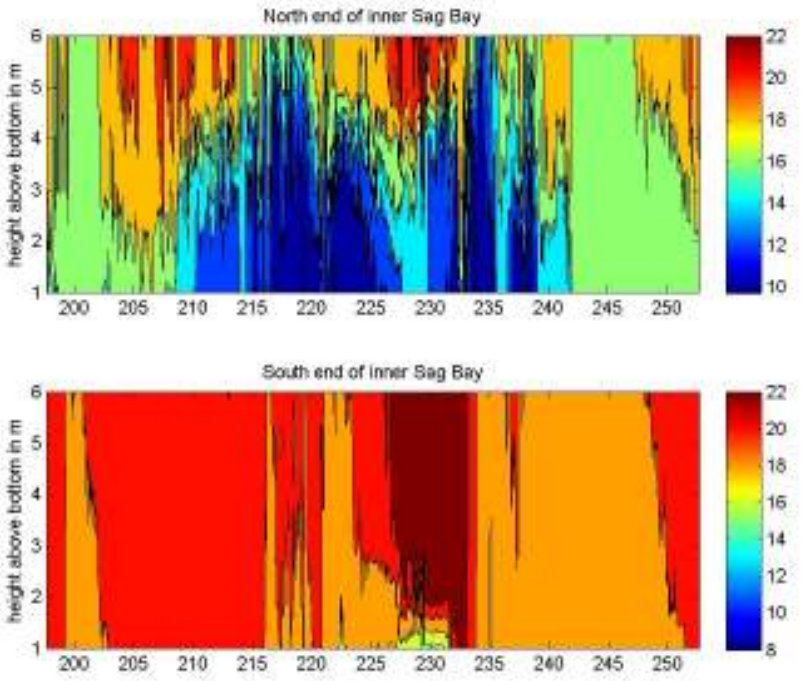
- Water quality
- Fisheries
- Human dimensions



We've already learned a few things…

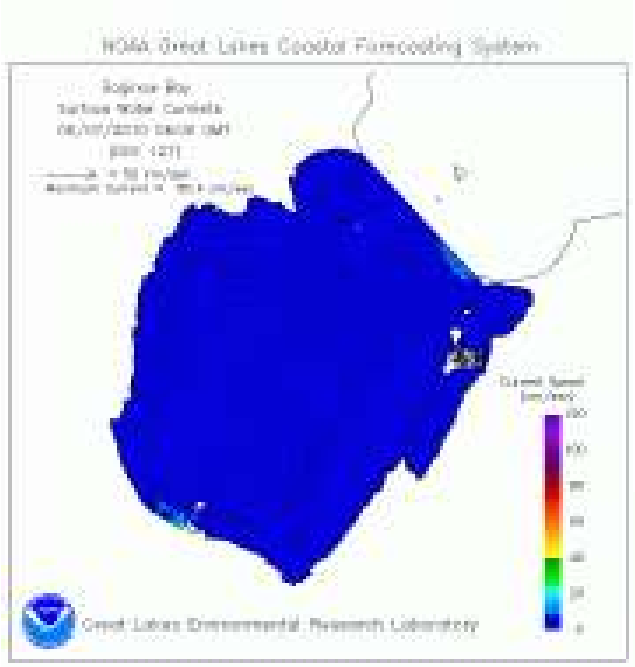


- Eutrophic
- Shallow: mean depth 5m

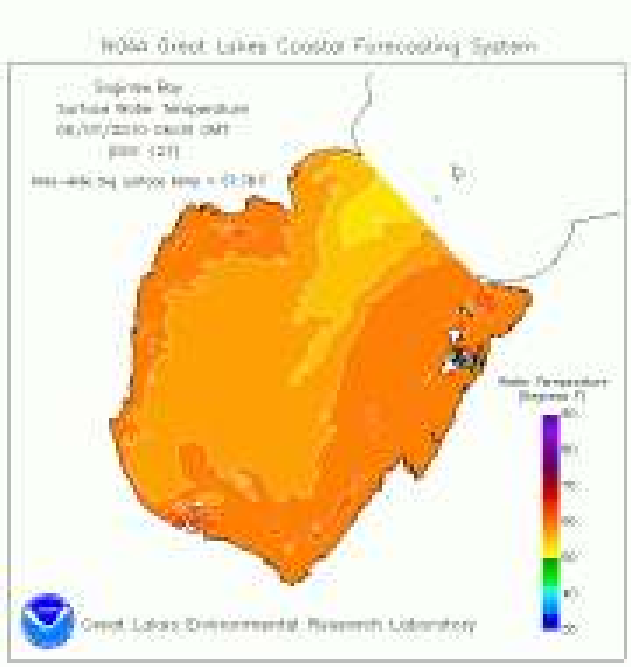


data courtesy of
Nathan Hawley

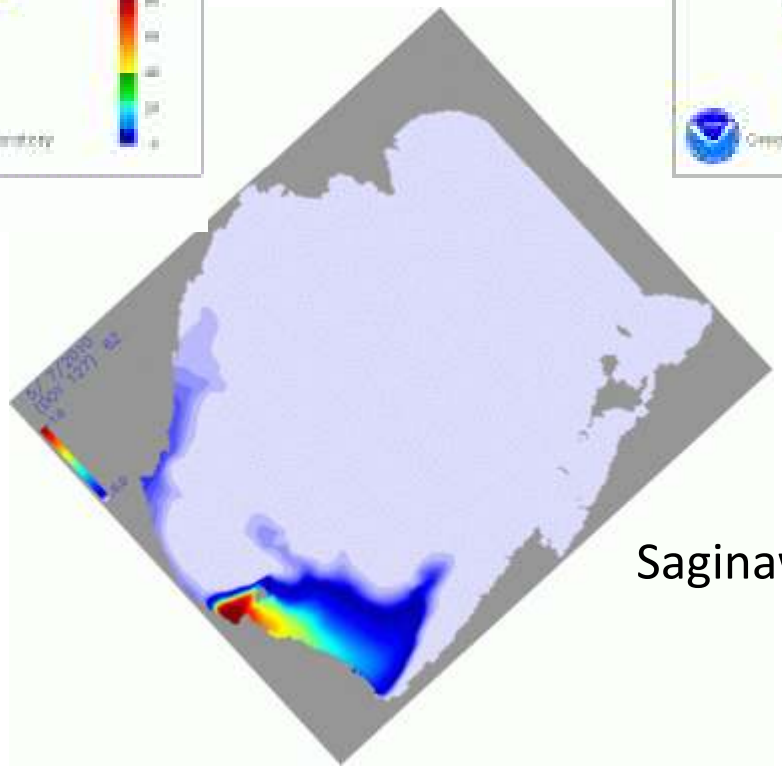
Real-Time Information On Web



Currents



Temperature



Saginaw River Plume

http://www.glerl.noaa.gov/res/glcfs/sb/

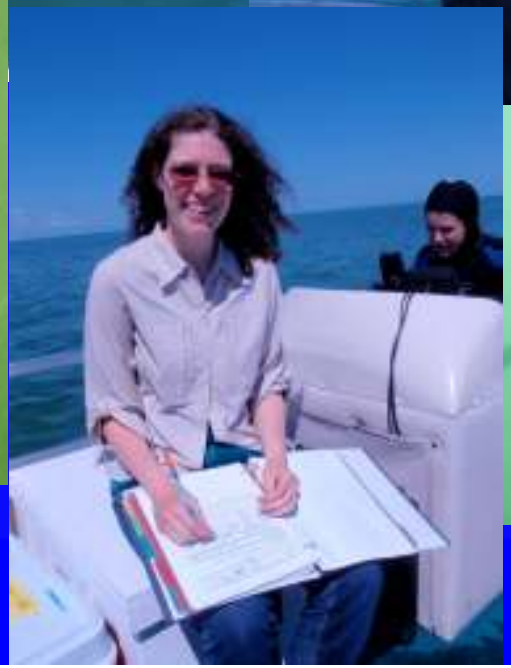
2009 Sampling

Benthic algae:

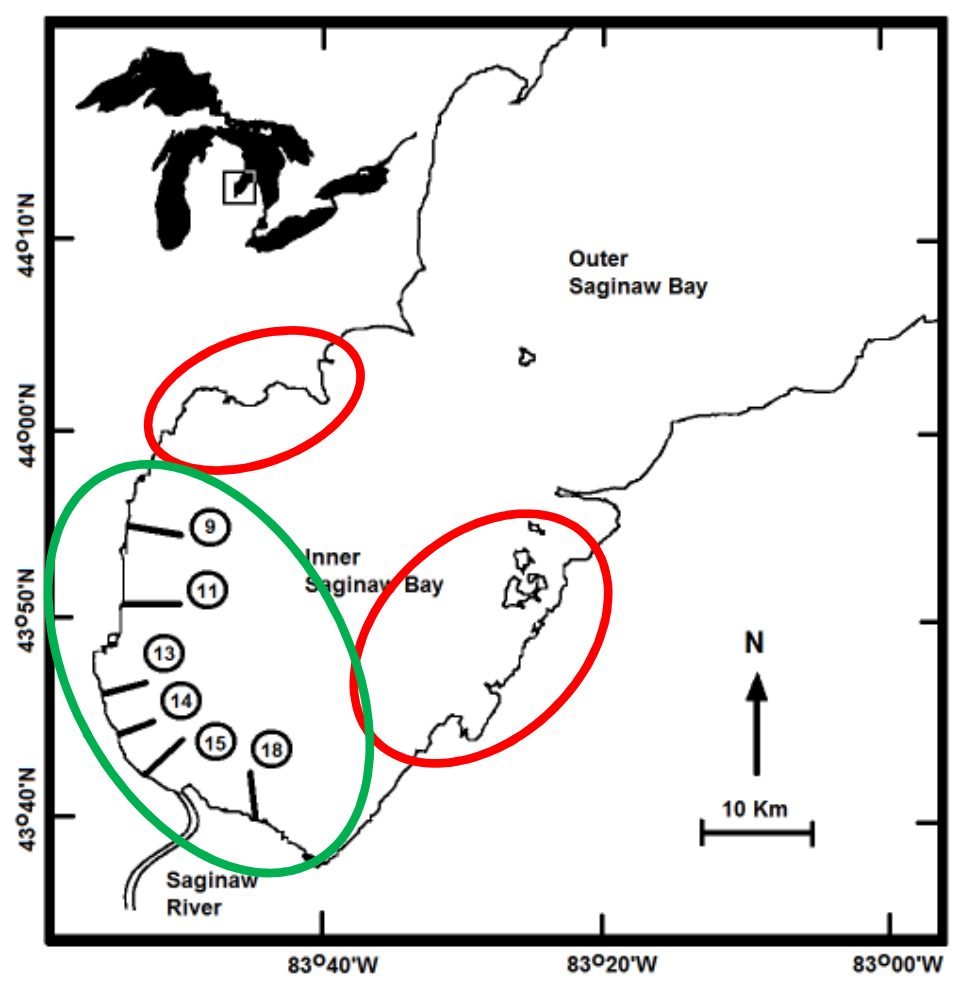
Diving and snorkeling survey

Benthic algae:

Diving and snorkeling survey

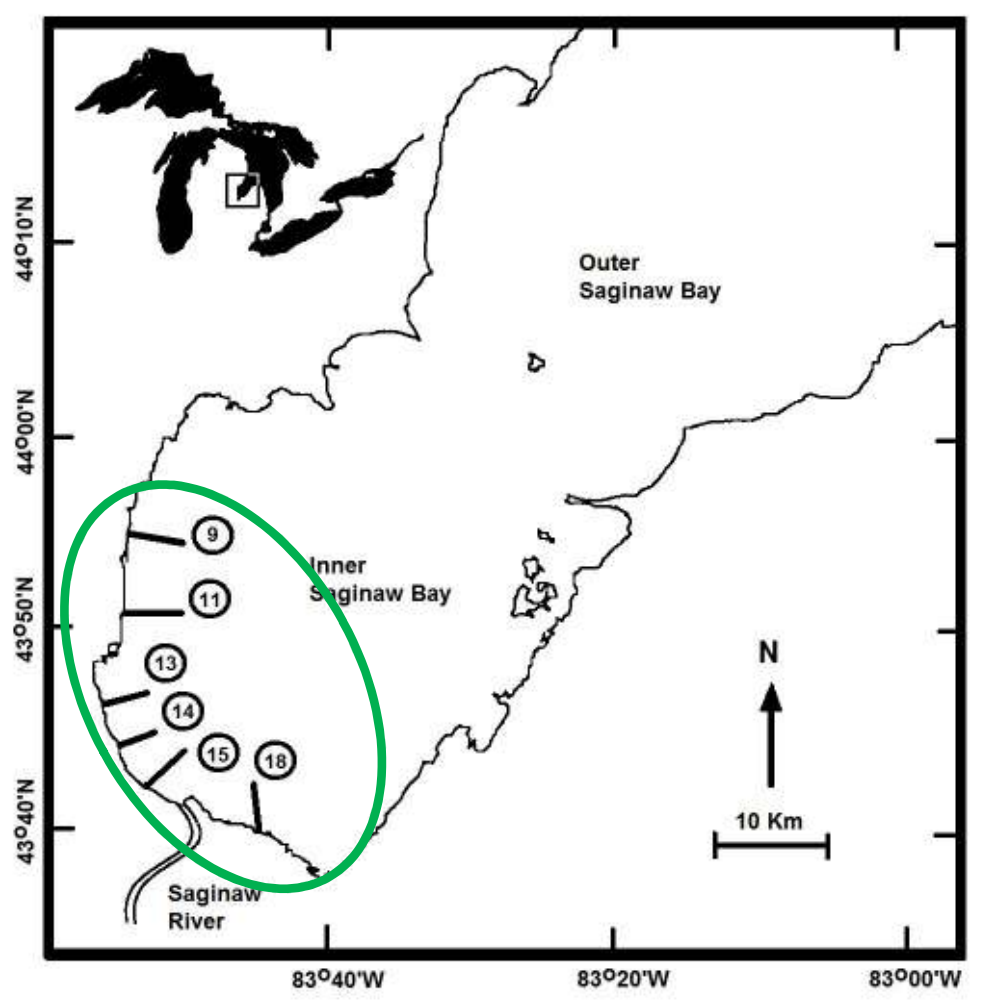


Benthic Algae Methods



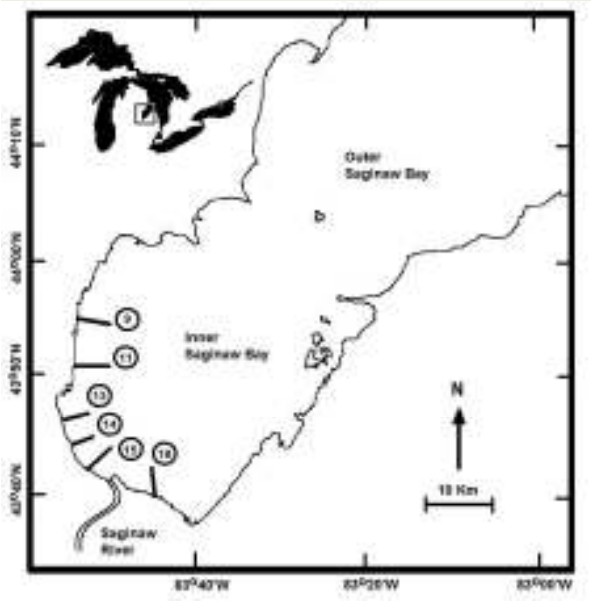
- Early season - surveyed entire inner bay
  - Mixed substrate
  - Found primarily *Chara*
  - Some macrophytes
  - Little filamentous algae growth, mostly in southwestern region

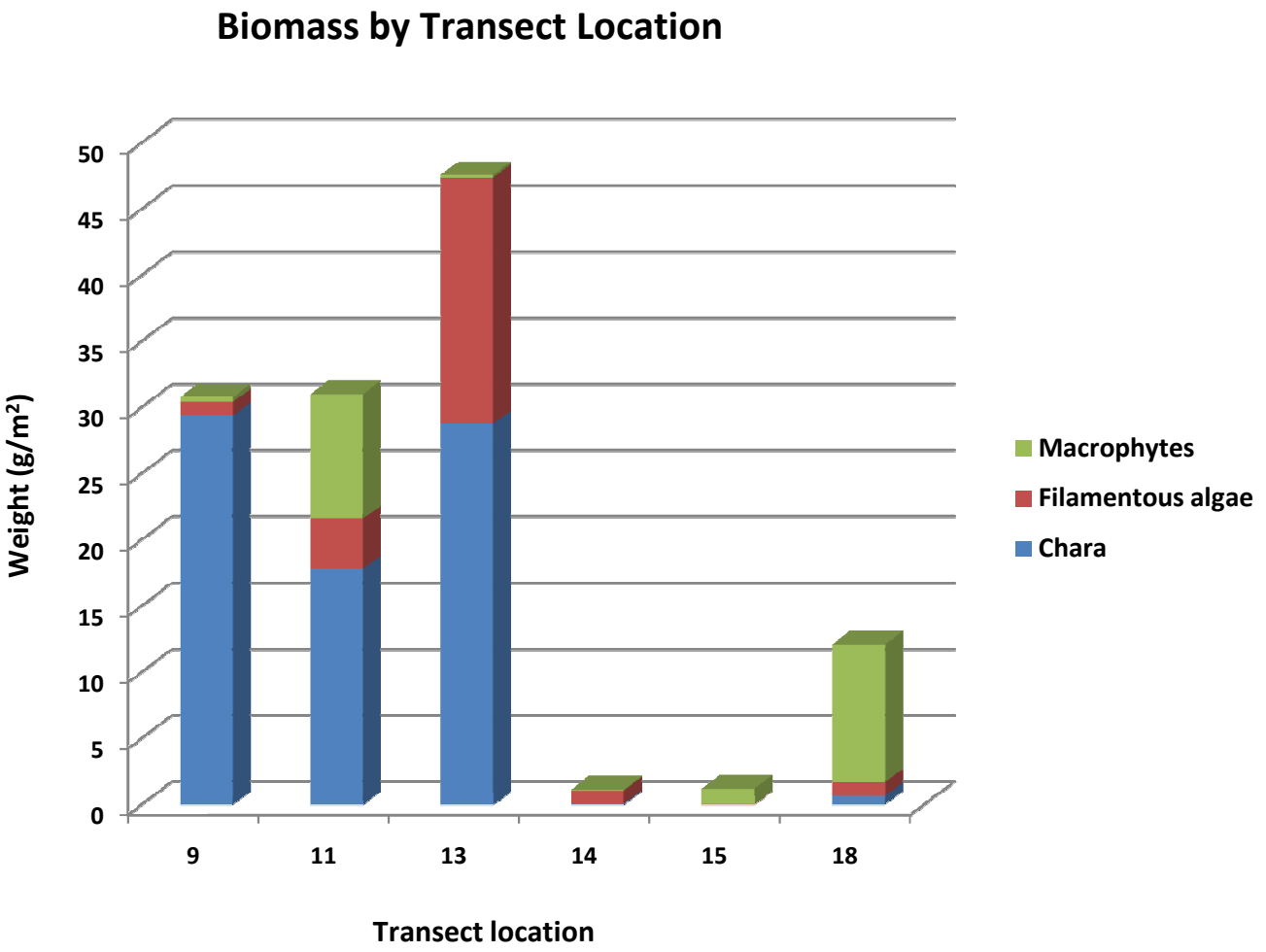
Benthic Algae Methods

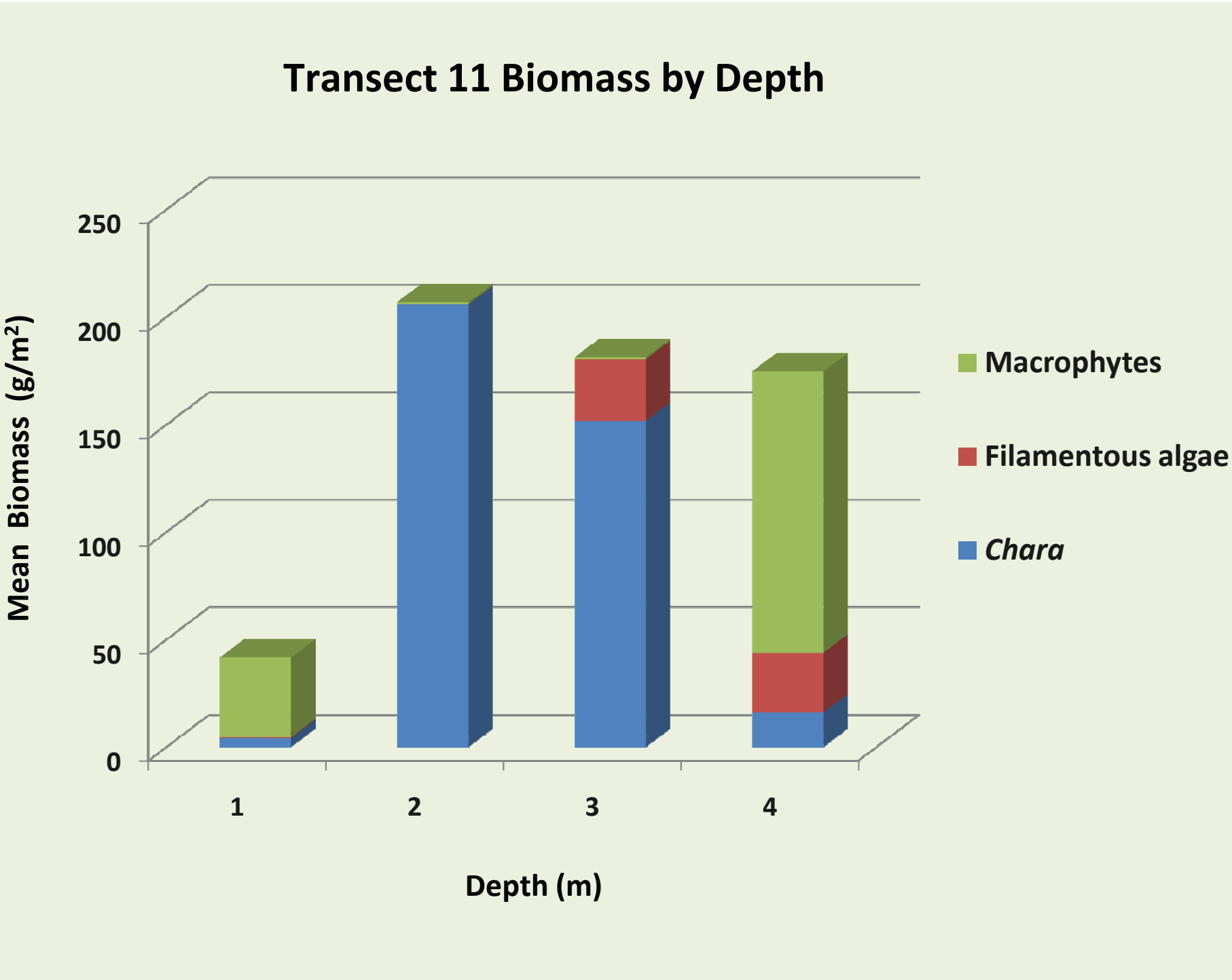


- Focused efforts in southwestern inner bay
- Six transects:
  - Depths: 0.5, 1.0, 2.0, 3.0 , 4.0 meters
  - Deeper if algae still present
- Surveyed all transects twice (July and August)
- Transect 11 surveyed five times between July and September

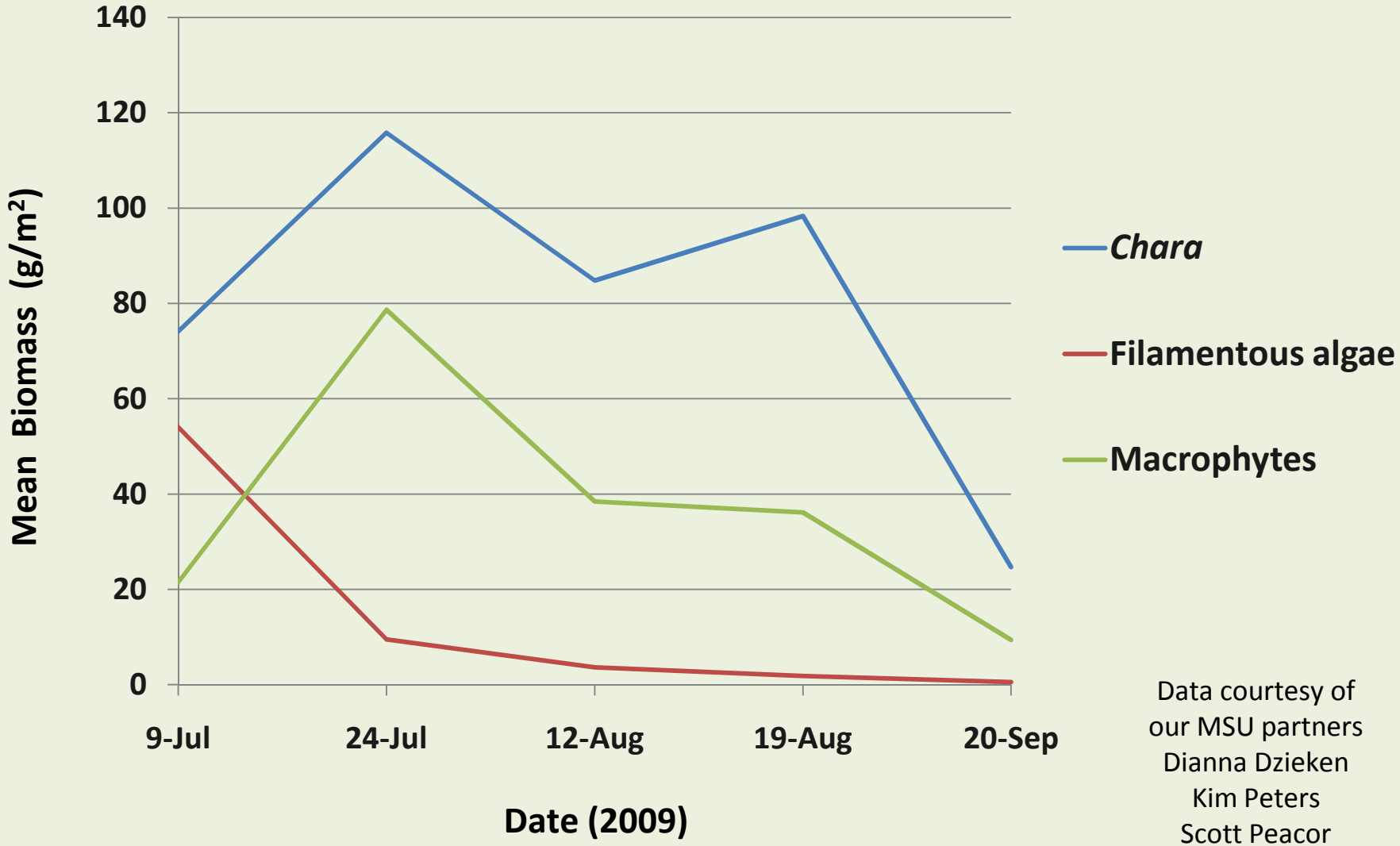
2009 Benthic Algae






Transect 11 Biomass by Depth
Mean Biomass (g/m²)
250
200
150
100
50
0
1
2
3
4
Depth (m)
Macrophytes
Filamentous algae
Chara

Transect 11 Biomass over Time



Data courtesy of
our MSU partners
Dianna Dzieken
Kim Peters
Scott Peacor

1978 GLWQA

Hear ye! Hear ye!

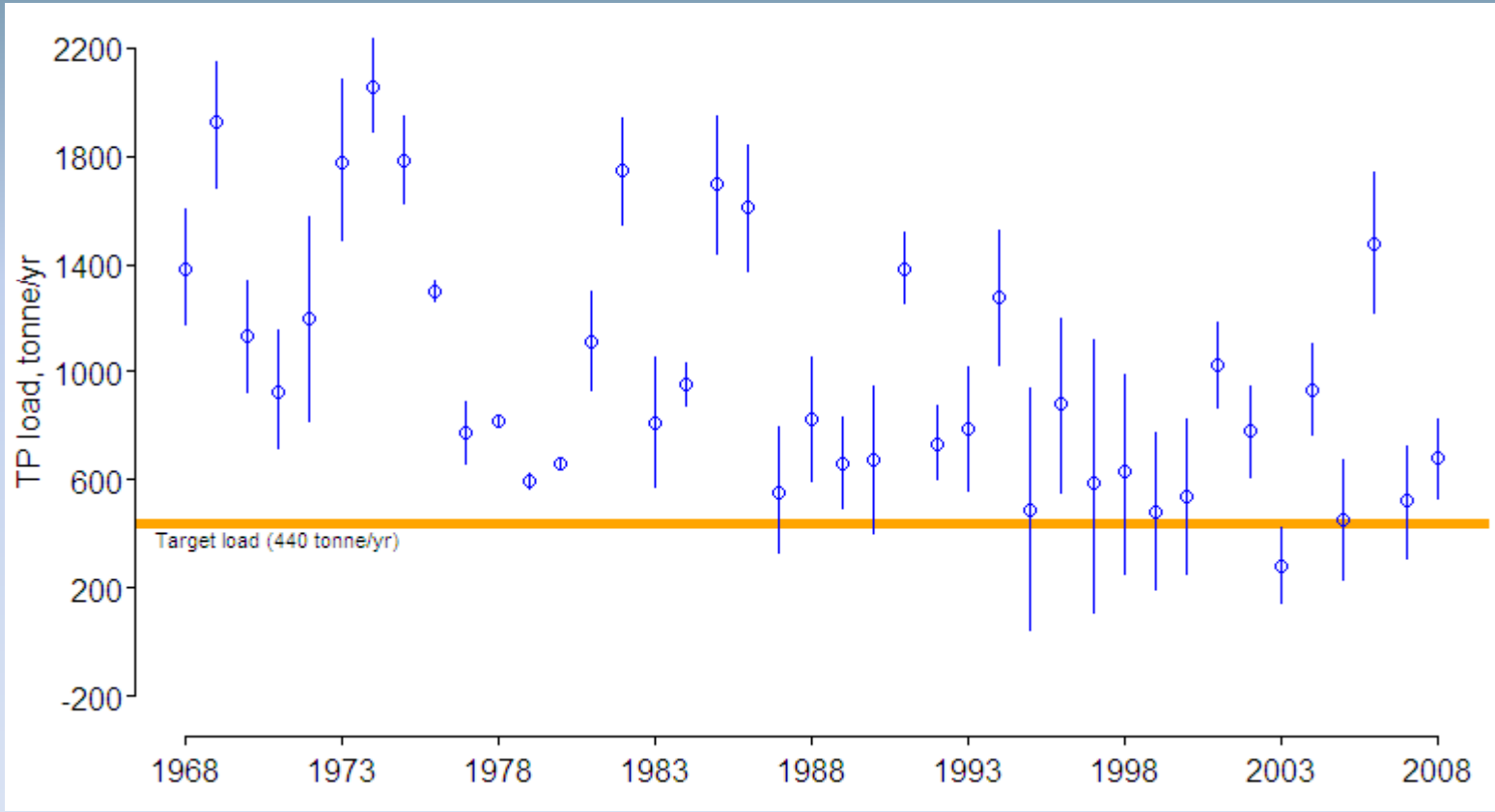
By Joint Proclamation
Henceforth and foreverafter

Saginaw Bay shall meet a target phosphorus load of:

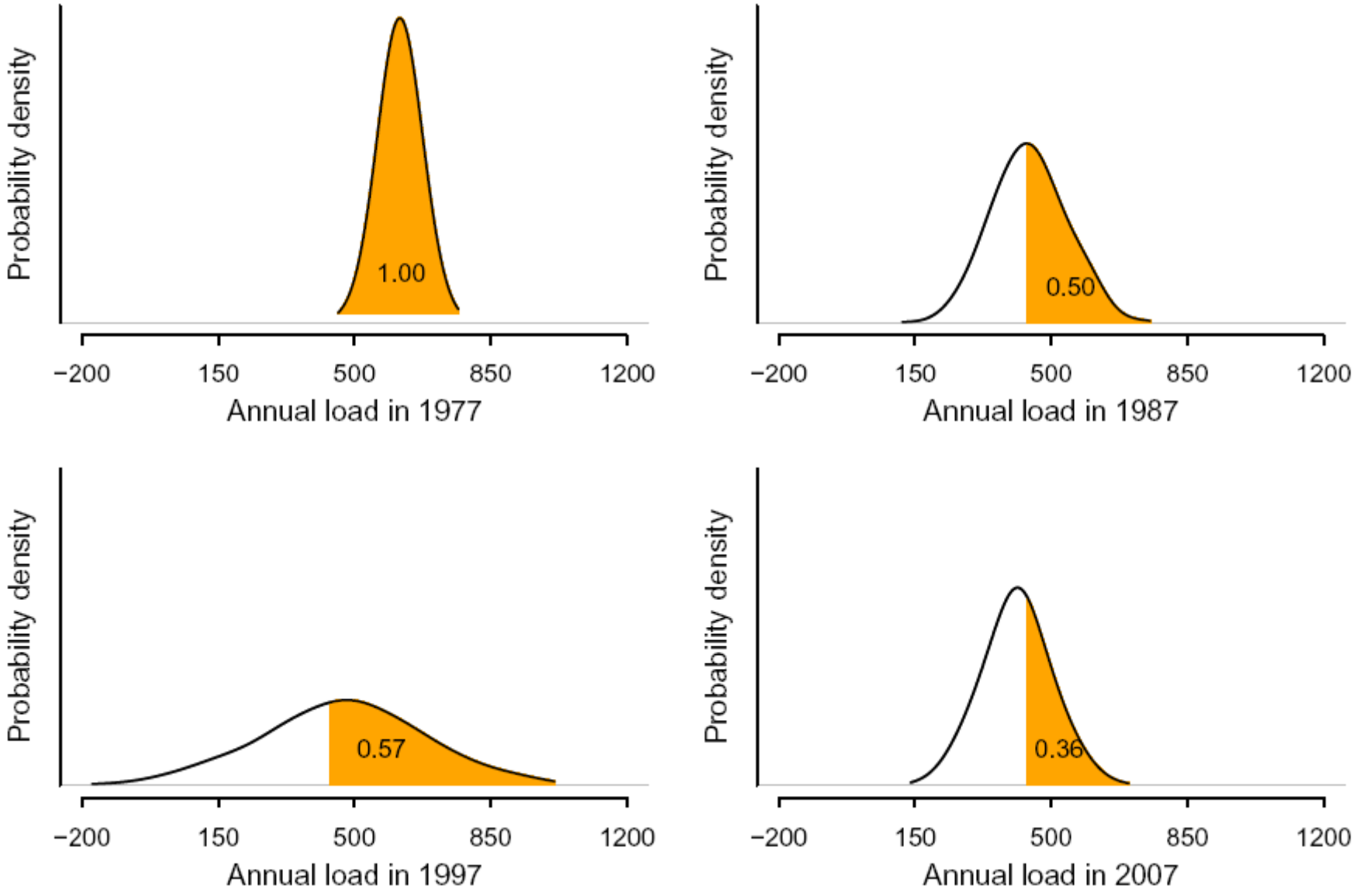
440 tonnes/year

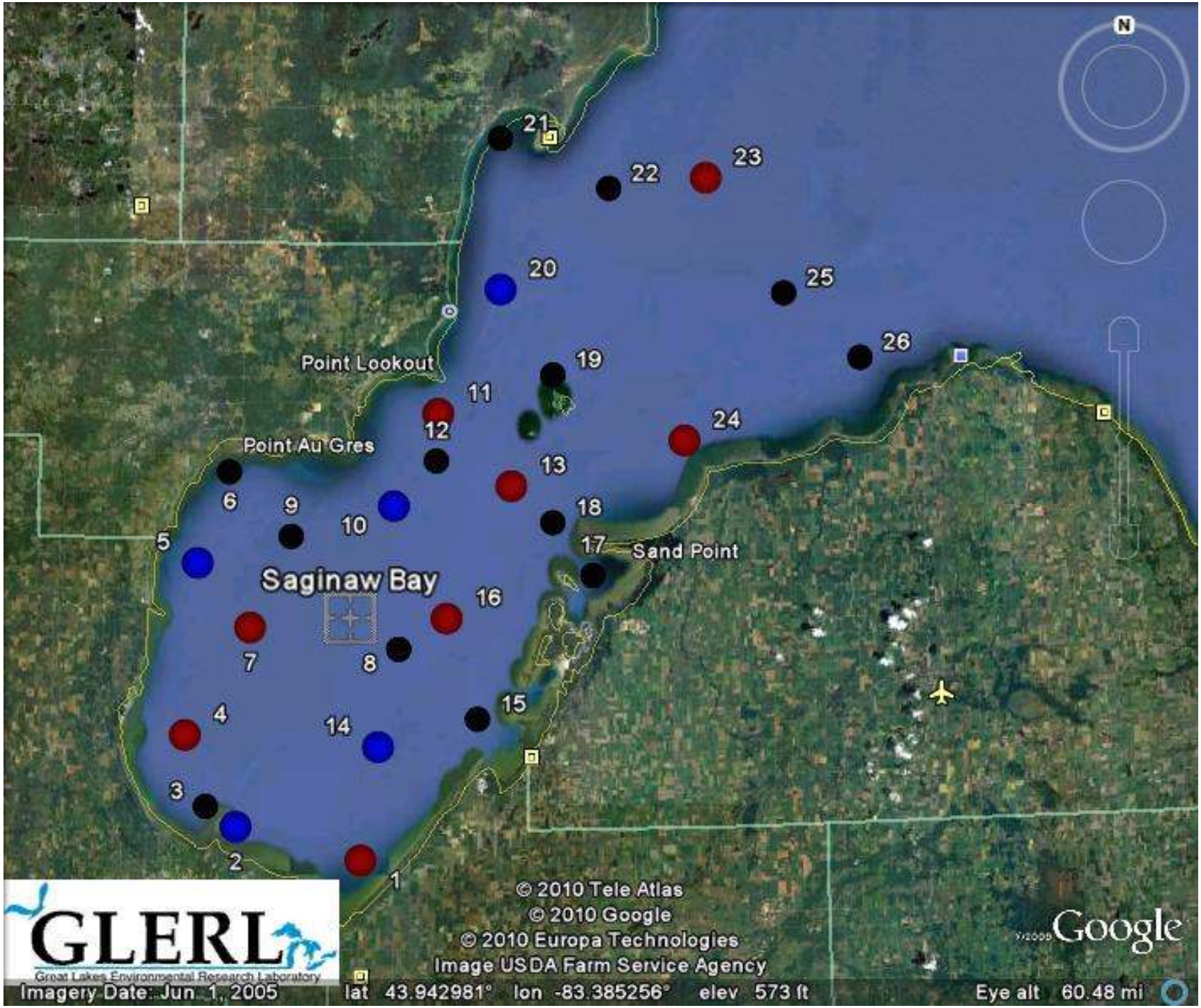
which probably translates to about 15 ug/L

Total Phosphorus Load vs. Time (with uncertainty)



p (annual load > 440 metric tons / yr)

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Point Lookout
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Point Au Gres
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Sand Point
Saginaw Bay
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© 2010 Tele Atlas
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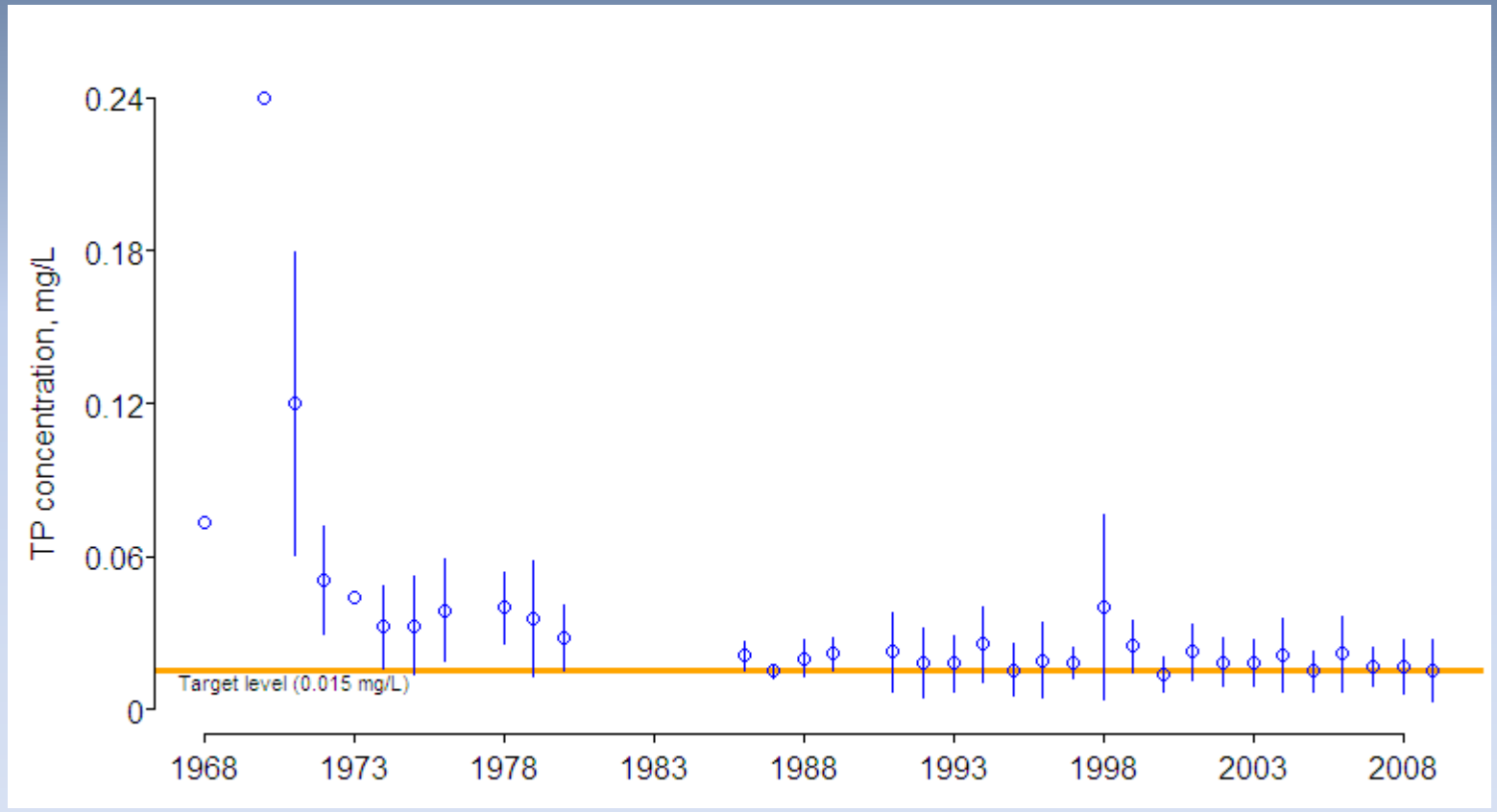
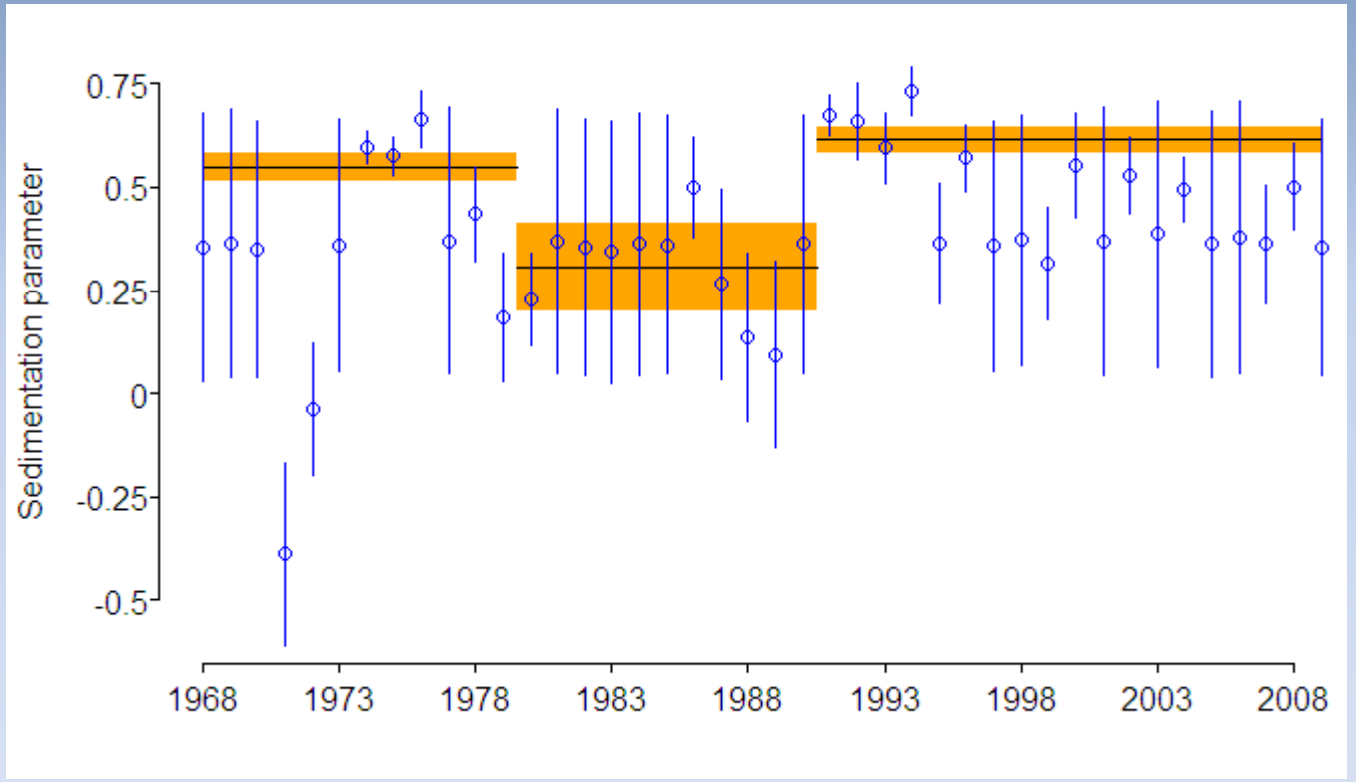
© 2010 Europa Technologies
Image USDA Farm Service Agency
GLERL
Great Lakes Environmental Research Laboratory
Google
Imagery Date: Jun 1, 2005
lat 43.942981° lon -83.385256° elev 573 ft
Eye alt 60.48 mi

Total Phosphorus Concentration vs. Time (with uncertainty)



What's the role of the Dreissenid Mussels (zebras and quaggas)?

Saginaw Bay Phosphorus Sedimentation vs. Time (with uncertainty)



2009 Dreissenid Observations

- SCUBA divers observed that benthic algae growing on mussels appeared “healthier” and greener than algal growing on other substrate

In Saginaw Bay:

Transect 11, 3.0 m
August 15, 2009

	Cladophora Filament Length (cm)	
	On Mussels	On Rock
Mean	3.26	2.04
Std.Dev.	2.03	1.00

In Lake Michigan:

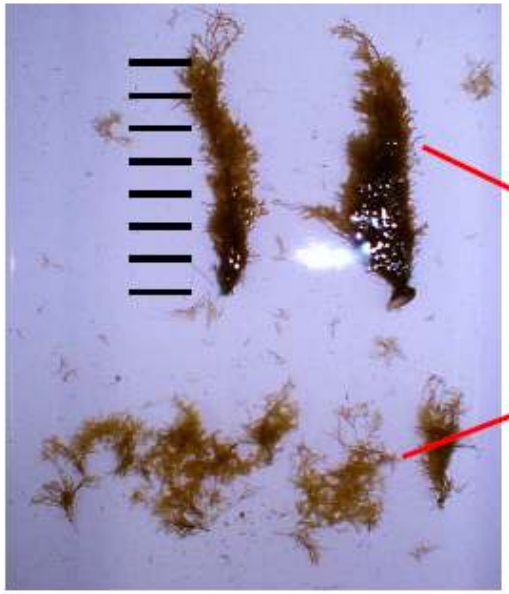
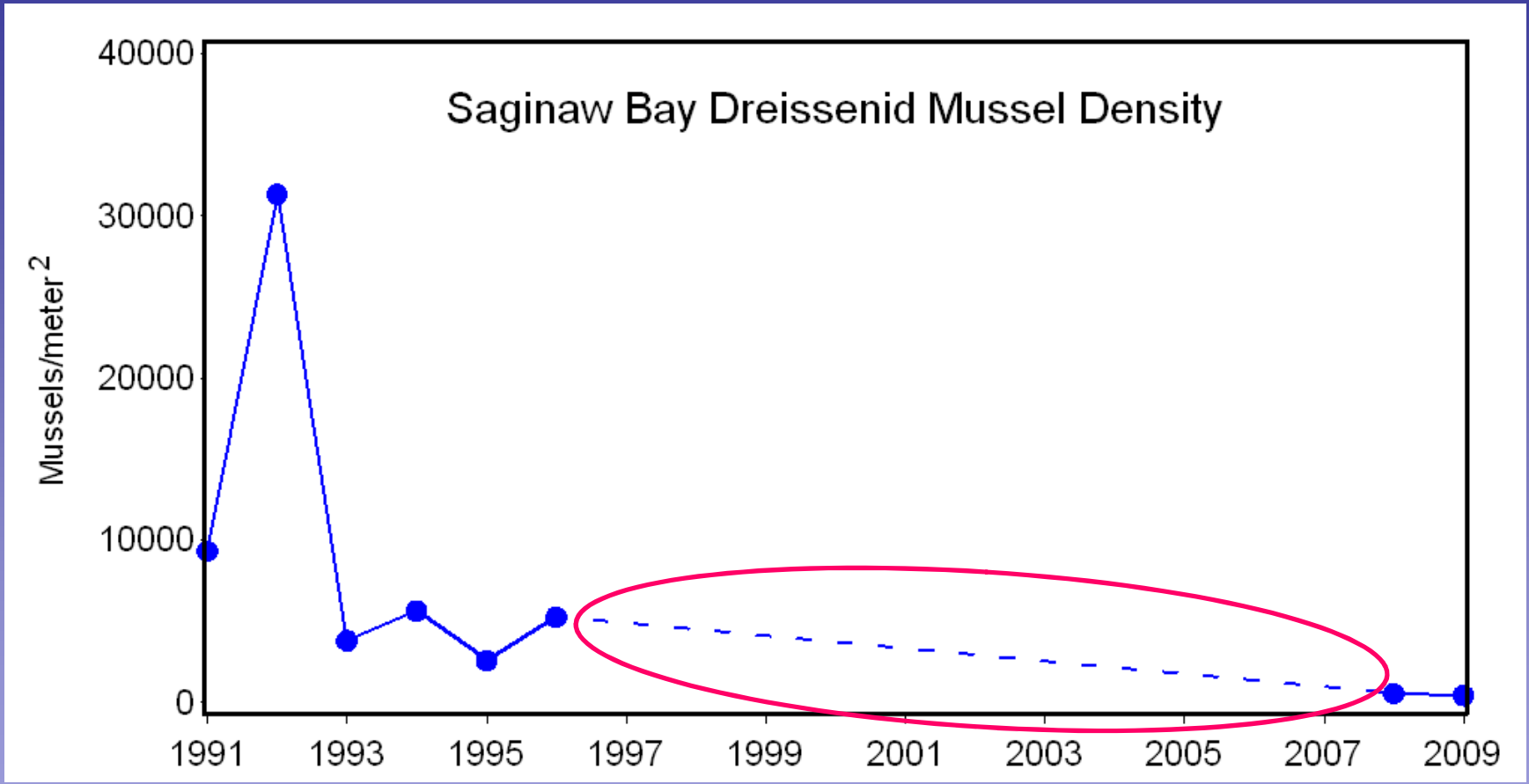
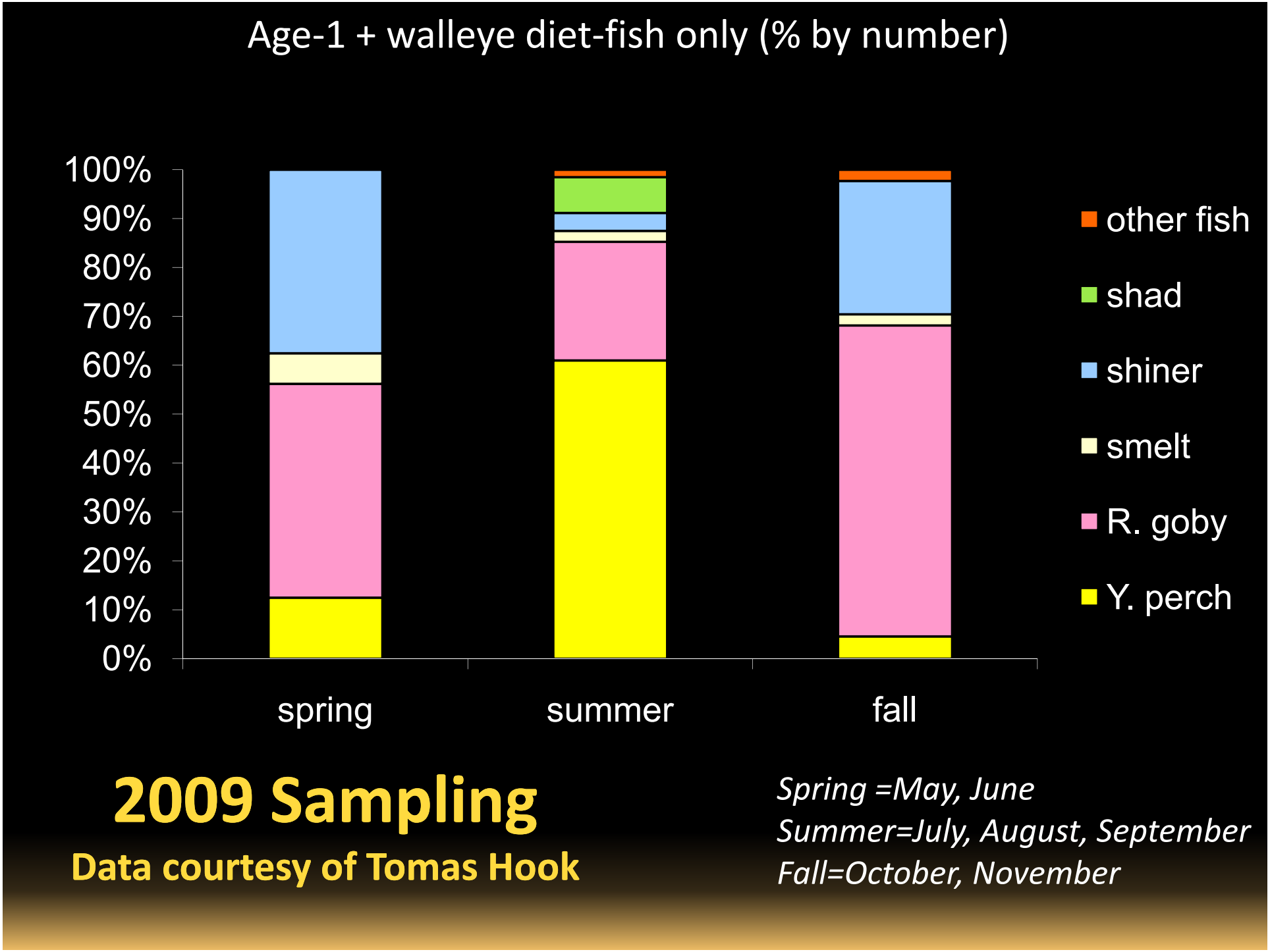


Photo from Bootsma et al. 2006



Data courtesy of Tom Nalepa


Age-1 + walleye diet-fish only (% by number)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
spring
summer
fall
other fish
shad
shiner
smelt
R. goby
Y. perch
2009 Sampling
Data courtesy of Tomas Hook
Spring =May, June
Summer=July, August, September
Fall=October, November

Microcystis in the Great Lakes

- Colonial harmful algal bloom species (HAB)
- Forms blooms and scums
  - Taste/odor issues
  - Loss of recreational and fishing value to affected waters
  - Hypoxia/anoxia, may lead to mortality in benthic invertebrate community and fish kills

Microcystis

Summary

Some Surprises

- Mussel densities down
- Mix of benthic algae – seasonal progression?
- Periodic vertical stratification

Still some big unknowns

- Do mussels supply phosphorus to benthic algae?
- Link between water levels and muck?

Plans for this year

- Ambient Water Quality Survey
- Fishery Survey
- Buoy and sensor deployment
- Current meter deployment
- Benthic algae survey
- Mussel Survey
- Experiments on mussel/phosphorus interactions

What can we do?

Revisit expectations

- Broken vs. Fixed – old view
- Lake continuously change and adapt
- Recognize uncertainty
- Improvements may be gradual

Support those who must adapt

Support long-term monitoring